

Article by Alexander Graham Bell, undated

EXPERIMENTS IN VENTILATING AND HEATING HOUSES By Alexander Graham Bell From The Beinn Bhreagh Recorder

1912, Oct. 17: I have had the Annex of my house in Washington remodelled to test my ideas concerning the ventilation, and cooling and heating of houses.

The cooling arrangement worked so well this last summer, that I hope it will be equally satisfactory, when we come to warm the Annex this winter.

For the information of Mr. George Oakley Totten Jr, the architect of the building, I will briefly describe the principles to be adopted in providing for the warming of the big room.

WARMING THE BIG ROOM

First: The Annex consists of a room within a room. The inner or "living room" is open at the top, with a hood covering the opening, so as not to interfere with the escape of the hot foul air at the ceiling into the attic. The outer room is closed at the top, (or should be for winter use) to prevent the escape of the heated air into the outside atmosphere. There is an air space of several inches between the walls of the two rooms, which includes quite an attic at the top.

The hot and foul air from the living room goes into the attic where it gradually becomes cooled by contact with the cold roof of the Annex and with the outside walls. It is then cooler, and therefore heavier, than the hot air streaming up from the living room, so it begins to settle down, allowing the warmer air to take its place.

GETTING RID OF THE FOUL AIR

Now this cooling air contains, by hypothesis, all the foul air of the living room—the air given off from the lungs, the products of combustion of gas jets and so forth—and it is important that these cooled impurities should not return to the living room to be re-breathed by the occupants there.

This is secured by the guard over the opening in the ceiling of the living room which prevents the cooling air from falling directly backwards into the room, and directs the flow into the interspace, between the walls, where it can gradually settle down and get cool without injurious effects to the occupants or to the heating of the room.

The air in the interspace, though gradually becoming cooler as it sinks down by contact with the cold outside wall, is warmer than the atmosphere in the winter time; and thus warms the walls of the living room. It cannot escape through the outlet holes provided below, until it has parted with a great portion of its heat, thus economising fuel.

It is obvious that if the hot air in the attic were allowed to escape into the atmosphere through a ventilator in the roof its place would have to be supplied by the expenditure of more coal in the furnace.

PROMOTING VENTILATION

I would suggest that a good way to promote the escape of the cooled foul air in the interspace between the walls, would be to connect the interspace by means of a large pipe with the furnace fire, so that the fire should be fed by the air of the interspace. Incidentally, obnoxious impurities contained in the interspace air would be burnt up in the furnace fire.

An auxiliary means of promoting the ventilation of the living room would be to pump in fresh air by means of electric rotary fans. In the winter time however the outside air is too cold to be pumped in directly, and would require to be slightly heated before admittance.

FRESH AIR ADMITTED SHOULD BE COOLER THAN THE BREATH

Now comes the important point, what temperature should this air have when admitted.

In order that the air exhaled from the lungs should rise into the interspace between the two ceilings the following general principle becomes obvious:—The general temperature of the air in the living room must be lower than the temperature of the exhaled breath.

If the air in the room is colder, and therefore heavier than the breath, the air exhaled from the lungs will at once seek the attic and escape from the room. It will bob up to the highest point, like a cork released under water.

If the living room contains air that is hotter, and therefore lighter than that exhaled from the lungs it will prevent the breath from escaping from the room. The hottest air will always go to the top.

The principle then is clear that whatever heating arrangements we employ, none of the air within the living room—even at the ceiling—should be hotter than the breath. Then the warm impure air will float up into the attic, and never return.

WHAT IS THE TEMPERATURE OF THE BREATH?

Now comes the question: What is the temperature of the breath?

It starts from the lungs at blood temperature (about 98 degrees) but it is considerably cooler when it escapes from the mouth. Experiments I have made seem to indicate 80° as a reasonable temperature for the emergent breath.

We want therefore, to arrange our room so that air at 80° would at once float up into the attic and escape from the living room.

This means that the general temperature of the air in the living room should be very much less than 80°.

THE COLDER IT IS THE BETTER: CONSISTENT WITH COMFORT

The colder it is the better, if we wish to get rid of the foul air from the room. Where then does the inferior limit of temperature lie?

The colder the air is, absolutely without limit, the more certainly will we get rid of the impure air in the room, because it is warm and therefore lighter than cold air.

So far as health is concerned it is well known that cold air is more acceptable to the lungs than hot air, at least within the limits naturally found upon earth. Our Arctic and Antarctic travellers are free from many of the diseases found in temperate and tropical climates. So far as the lungs are concerned the winter air might be freely admitted into the room without injurious effects to health.

The only thing that limits the coldness of the air admitted is comfort. The coolest air consistent with comfort is the best.

Our upper limit is 80° and I think we might place our lower limit at 60°. This is consistent with the well known point that 65° Fahrenheit is the ideal temperature of the air for both health and comfort. The air admitted to the room should not therefore be hotter than about 65° Fahr.

ANY ADDITIONAL HEATING REQUIRED BY COMFORT SHOULD BE SUPPLIED BY RADIANT HEAT

This applies of course, only to the the air. There are many persons who would like to be absolutely baked in a room; and I see no reason why radiant heat should not be employed to any extent that may be desired.

Radiant heat does not warm air. On a cold winter's day you may roast yourself before a bon-fire in the open air and yet freeze at the back. You may receive any amount of radiant

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heat upon the person, and yet breathe cool air. I see no reason why radiant heat from hot water radiators or even from an open fire might not be used in our living room.

The only objection to hot-water or steam radiators is, that they heat the air by contact. All air heated above the temperature of 80° Fahr will float above the exhaled breath and prevent its escape from the room. So that it would probably be advisable to collect this heated air in a hood over the radiator and lead it into a chimney through which it may escape outside. Should it enter the attic it would prevent the escape of the cooler foul air from the living room. If the temperature of the radiators should be well under 80° no harm would be done.

On the whole, I think open fires will prove more acceptable as they will supply radiant heat of great intensity without materially heating the air of the room. Of course the greater part of the heat of an open fire goes up the chimney and is thus wasted. Still as the radiant heat is for comfort, we may be willing to pay for it.

Summary The air of the room to have a temperature of about 65°, and any further heat required for comfort to be supplied by open fires.

Steam radiators, or hot water radiators might be used if the heated air streaming up from them should be led into a chimney and not let loose into the room, so that persons should be warmed by the radiant heat given off and not by the heated air. There could be no objection to warm water radiators not heated to a greater temperature than 65° Fahr or thereabouts.

CLEANSING & MOISTENING THE AIR ADMITTED

The fresh air supplied to the room should, before admittance, be passed over warm water radiators so as to have the chill taken off and so as to acquire a temperature of about 65°.

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During this process it would be well to expose the air to water, as the cold winter air (which is dry) would become still drier with increased temperature. By passing it through a water spray, or through damp material of any kind, it would be cleansed as well as moistened.

Supply the room with pure, filtered, moistened air at about 65° Fahr forced in, in quantity, by electric rotary fans.